Program Objectives

1. Detect changes in elk abundance, distribution, and herd composition by conducting aerial surveys at Mount Rainier and Olympic National Parks.
2. Detect changes in elk use of habitat within and surrounding Lewis and Clark National Historical Park using an index of relative use, the proportion of area (PAO) occupied by elk, and the rate at which elk are sighted during roadside surveys.

Bottom Photo: A herd of Roosevelt elk is detected on a late summer survey in the upper Hoh valley, Olympic National Park. High resolution photography is used to get complete counts and accurate classification of bulls, cows and calves when large herds are encountered. NPS/OLYM

Elk

THE HELICOPTER GLIDES DOWN THE HOH RIVER VALLEY, its blades flickering in the pre-dawn light. One of the four people inside mentions that they see something tan in the trees below, and the pilot arcs the helicopter back to investigate. They pull up and circle above a herd of about 20 elk. The observers inside count the number of elk in the herd quickly to avoid disturbing them, trying to be accurate despite the helicopter's tight circles and the fact that even at only 100 feet above the treetops, each massive elk is the size of a grain of rice. When the observer finishes his or her count, the pilot arcs the ship back onto the transect to search for more elk. The data from these surveys help scientists determine the status and distributions of elk populations in and around Pacific Northwest National Parks, providing critical information about ecosystem health in these regions.

Elk are important ecologically, culturally, and economically. These stately members of the deer family range widely, greatly affecting the ecosystems they occupy. They are important grazers and serve as prey for bears and cougars. Elk were also key players in Pacific Northwest history as a food source for native tribes and early settlers and expeditions, and are valuable economically for wildlife viewing, and for hunting activities outside of national parks.

Perhaps most importantly, elk have a sensitive relationship with their environment, making them excellent indicators of long-term ecosystem health. National Park Service (NPS) scientists monitor elk in three North Coast and Cascades Network (NCCN) parks as part of the Vital Signs monitoring program: Olympic National Park (Olympic), Mount Rainier National Park (Mount Rainier), and Lewis and Clark National Historical Park (Lewis and Clark).

"Elk are an important natural resource in all three parks. They move in and out [of the parks] and they're a really central part of the history. Elk are also important ecologically," said Dr. Paul Griffin, a United States Geological Survey (USGS) wildlife biologist working with the NPS to develop the new elk monitoring protocols.

By: Emily Linroth

Elk greatly influence their environments, affecting the cycling of nutrients and the structure and composition of plant communities. Surveying elk may give NPS scientists more information about whether or not trampling in the high country of Mount Rainier has caused excessive erosion, if browsing pressure in Olympic is changing forest composition and structure, and how elk are responding to wetland restoration projects in Lewis and Clark. Changes in elk biology may result from changes in climate, use of neighboring lands, fire effects, subalpine ecology, and plant cycles, which are also important topics of investigation.

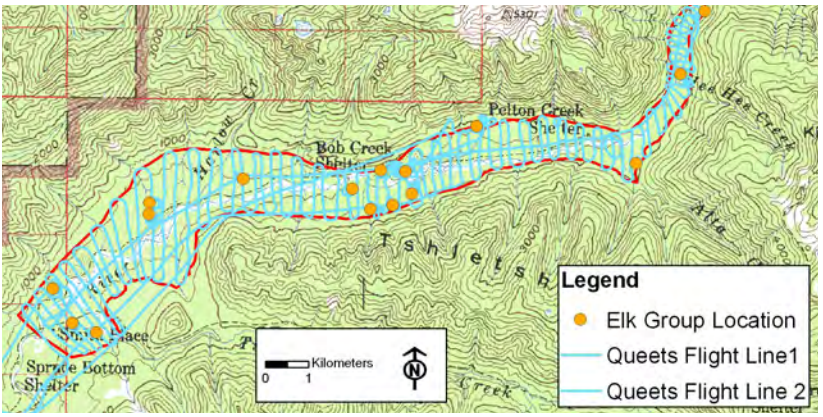
NPS scientists monitor trends in numbers and distribution of elk, and track changes in that use over time. Researchers in the two larger parks monitor elk abundance, distribution, and herd composition during summer, and elk abundance and distribution at Olympic in late winter. Trends in these data help scientists determine how elk respond to changes in habitat, predation, climate, and disease both within and outside park boundaries.

The current monitoring protocols are the result of a 20-year cooperative effort between the NPS, USGS, state governments, and local tribes. Scientists developed two separate protocols because monitoring large parks like Mount Rainier and Olympic requires different methods than monitoring smaller parks like Lewis and Clark.

Mount Rainier and Olympic National Parks

Researchers have used aerial surveys to monitor populations of elk in Mount Rainier and Olympic since the 1980s. Earlier helicopter surveys used numbers of elk seen to estimate the total number of elk in an area and trends in elk use. NPS scientists worked with the USGS to combine old monitoring strategies into a new, more accurate model for the current protocol.

In both of the large parks, elk monitoring goals focus on detecting changes in where elk are located, the number of elk in those areas, and (in summer) the proportions of calves, cows, and bulls within those populations. Teams of observers in small helicopters scan low- and high-elevation terrain in these parks for elk, using GPS to make sure they stay in the designated sampling areas. Elk are more active in the morning and evening, so the monitoring crew takes off before sunrise and is usually back on the ground about four hours later, or starts surveys in late afternoon and is on the ground before sunset. The pilot flies the helicopter relatively slowly, between 35 and 50 miles per hour (between 48 and 80 kmh). Each of the four people in the helicopter is an observer, including the pilot. Most observers are wildlife biologists, and crews at Mount Rainier include representatives from the NPS, local tribes, and Washington Department of Fish and Wildlife (WDFW). During winter surveys at Olympic, teams only count the total number of elk per herd, not



Flight line and location of elk groups seen on the late spring survey, Queets valley, Olympic National Park, 2010. Data was gathered through the use of a GPS that was in the helicopter during the flights, and later transferred to a digital map.

herd composition, because the bulls have dropped their antlers and are difficult to distinguish from cows. In summer, observers classify elk as calves, cows or bulls, and then further classify bulls as mature and immature. These composition observations indicate the productivity of the group.

The program uses a double-observer sightability method to compensate for elk that are present, but not seen, during surveys. In the helicopter, each observer scans for elk independently, and the crew records which observers in the helicopter saw or missed each elk group. Any elk group that includes a radio-collared elk can be found using radio-telemetry, even if all four observers in the helicopter missed it. Based on hundreds of records from elk groups under a wide variety of conditions, scientists develop a statistical model that predicts each elk group's detection probability. After the model is developed, the appropriate correction factor is applied to each group that was seen in surveys so that the total estimate of elk in the survey area accounts for animals that were missed. The front of the helicopter is a plexiglass bubble, through which the primary observer constantly scans forward, below, and backward in his or her search for elk. The two backseat observers search for elk out each side of the helicopter. After both the front and back observers have had an opportunity to see the elk, the helicopter goes back for a second pass, orbiting alongside the herd until the crew has recorded a complete count of all elk, classified by sex and age, and has marked down the time and location of the sighting, the activity level and size of the group, and any variables affecting detectability on the data sheet. Elk don't respond much to the helicopter, said Dr. Patti Happe, wildlife branch chief at Olympic National Park. Sometimes groups that are bedded down will stand up and form a line, which makes them easier to count. Crews try to leave as soon as possible to minimize disturbance.

The protocol calls for the first person who sees an elk to not alert others in the ship of its presence until everyone has had a chance to see it. The primary observer can't jump or make any noise when seeing an elk until the secondary observer has passed over the elk as well. Then whoever saw the elk will notify the others via a helmet headset.

"The pilot I used to fly with used to punch me in the leg [when he saw an elk]," Happe said. "I used to jump at that."

Monitoring elk is more than a friendly competition. Observers must have keen eyesight, ability to focus for long periods of time, and a mental search image of what they're looking for. In this case, it's the telltale tan elk rump patch. Observers all have advanced helicopter training and use equipment like topographic maps, GPS units, and cameras while searching for elk—all the while battling fatigue and nausea from the helicopter's tight circles.

"It's actually really tiring because you're so focused for two hours straight," Happe said. "Occasionally, you'll get an 'elk rock' or an 'elk log,' and that's really embarrassing."

In the new method, scientists compare the proportion of elk seen and the conditions under which they were seen with the number of elk missed based on follow-up radio telemetry surveys. Multiple variables affect how easy it is to detect elk from the air—for example, group size, vegetation density, lighting, and activity levels. Large groups of elk are easier to see than small ones, but even large groups can spread out and can disappear entirely into tall vegetation and dense Pacific Northwest forests. In spring, elk are often found under a forest canopy, where contrasting sun and shadows make them difficult to spot from the air, particularly small groups of elk resting under or near trees. Preliminary results suggest that the aerial survey crews may see as few as 20 percent of the total elk in an area when contrasting light is an issue.

"If they're bedded down, they look more like rocks and it's easier to miss them, whereas if they're moving, your eye is drawn to that movement because they look more elk-like than rock-like," Happe said.

For large groups, crews take a high resolution photo to analyze later. Before heading into the air, crews make sure that the camera time and date stamp match with the GPS unit to keep track of which photos apply to which groups. One rather active group had 82 elk, Happe said, and observers couldn't tell if they were looking at antlers ("spikes") or ears.

"With pictures, they're standing still. And if they have four ears, it's a spike," Happe said.

For the winter surveys, crews can only fly in partly cloudy weather with no rain or wind. Sometimes the weather in nearby towns will be terrible, but the park valleys will have perfect weather, since the surrounding mountains have their own weather patterns. Crews may not be able to tell whether or not they can fly until 10 minutes into a flight—and because helicopters cost $1,000 per hour, they must decide quickly. But the aerial surveys give great data, and new methods provide more accurate counts than ever before.

"The whole goal of it is to try to figure out the proportion of animals we're seeing," Happe said.

Observers know that they are missing some elk during surveys, but the proportion they're missing is probably not constant. Sometimes observers miss 10 percent, sometimes 25, sometimes 50. The new method will help them predict what percentage of elk observers are missing and statistically correct for the elk missed to get more accurate total counts.

Scientists used radio collars during development of the new protocol, which is now under peer review. Although the collars are visible from the air, collared elk might be buried in the middle of a large group, hidden in trees, or between two transects when a crew is counting. After getting a final count on a herd, observers would turn on a receiver and check for any radio-collared elk in the area that they may have missed. They would then fly toward the signal and find the elk they missed.

"[These methods are] also bringing us up to industry standards, so our numbers will be more respected by other agencies," Happe said.

Capture crew members from Leading Edge Aviation process a cow elk in Olympic National Park. Her radio collar has a GPS on board and sends up to four locations a day via telecommunications satellite. Data from this cow will be used to refine census methods in the network.

Lewis and Clark National Historical Park

Elk play an important role in the history of Lewis and Clark National Historical Park. They served as a key source of food and materials for native tribes inhabiting the region long before the Lewis and Clark Expedition arrived in the winter of 1805. The abundance of elk around the Netul River (now called the Lewis and Clark River) contributed to the Corps' decision to set up camp at what would later become Fort Clatsop, where elk monitoring now occurs. Most importantly, elk are key indicators of ecosystem health. Ecologists at Lewis and Clark are implementing environmental restoration programs, and the health of elk populations helps indicate how these restoration efforts are working.

Lewis and Clark is too small to support a year-round resident elk herd, so elk range far outside of park boundaries, where they may be hunted, hit by vehicles, and funneled into fragmented or degraded habitats. Increased development along this scenic coastline is also expected to impact elk movement, behavior, and population size.

The goal for monitoring at Lewis and Clark is to detect changes in elk use of habitat within and surrounding the park. The protocol focuses on three measures: an index of relative use, the proportion of area occupied (PAO) by elk, and the rate at which elk are sighted during roadside surveys.

The small size of the park and dense forests make it nearly impossible to monitor by helicopter, so researchers at Lewis and Clark count elk fecal pellets to infer trends about elk use of the park. Elk relative use is measured by counting the abundance (average number) of fecal pellet groups at survey points distributed systematically throughout the Fort Clatsop unit of Lewis and Clark. Roadside surveys follow specified routes and can help park staff infer trends in the number of roadside elk sightings available to visitors.

Researchers at Lewis and Clark spend a week clearing elk pellets from plots in the fall, then return and spend a week counting elk pellets in the same plots in the spring. The Fort Clatsop unit of the park, where elk monitoring takes place, is approximately 1,000 acres (404 hectares) in size and contains 68 sampling points. Sampled points are systematically placed throughout the park, with roughly 820 feet (250 m) between points. At least three teams of two people each navigate the forests using GPS to locate points.

"We have really dense second- and third-growth forests here, and the rain seems to have a dampening effect [on the GPS receivers] as well," said Carla Cole, natural resources project manager for Lewis and Clark. When GPS doesn't work, teams must look for the small red flags that mark the points.

Group of elk pellets at Lewis and Clark National Historical Park. NPS/Liang

Teams try to sample five or six points per day. Much of the monitoring time is spent navigating through the nearly-impenetrable understory getting to these points. The observers spend about 30 minutes sampling each point, which is defined by an approximately 30-feet-in-radius (9-meter-in-radius) circular plot containing four subplots. Each observer surveys two subplots each, searching the dense vegetation for groups of elk pellets. When an observer finds a group of pellets, he or she counts the approximate number of pellets in the group and then classifies the group by how decayed the pellets are relative to each other, from one (fresh) to four (most decayed), by picking up the pellets and squeezing them. The number of pellets and how decayed they are could influence their probability of detection by an observer. Fresh pellets (class one) are smooth and shiny, and heavily decayed pellets (class four) may have plants growing out of them. Most pellets are level two or three as far as decay, with some pits and wrinkles on their surface. Crew members that have monitored for awhile don't use gloves, Cole said.

"They're herbivores—it's just plants," Cole said. "You get kind of jaded after awhile. I do use a little sanitizer before I eat my lunch though."

After counting their own subplots, teams flip a coin to randomly select which one of each others' plots to resurvey, searching for pellet groups that the other person may have missed. As with the double-observer method from the aerial surveys, data from recounted subplots will allow researchers to estimate the rate at which pellet groups go undetected. After finishing all counts, crews pick up the elk pellets and throw them out of the plots to prevent them from being recounted during future sampling sessions.

High winds, snow, and darkness sometimes force crews to cancel sampling. Clambering over fallen trees in full rain gear, even in ideal conditions, can be dangerous and tiring enough.

"It can be pretty burly work out here," Cole said. "Even though we're a little park, we've got lots of steep hills and blowdown. At the end of the day, you're pretty beat up and worn out."

Current Trends

Data from the aerial surveys and pellet counts will help scientists determine trends in sizes and locations of elk populations. Changes in habitat, disease movement, and predation both within and outside park boundaries impact elk populations and affect the overall health of these ecosystems.

Historically, elk foraged in low elevation forests and subalpine meadows throughout the Pacific Northwest in search of ferns, shrubs, lichens, forbs, and grasses. By the beginning of the 20th century, unregulated hunting of elk for their meat, antlers, and teeth, the latter of which were worn as ornaments and watch chains at the time, decimated populations in settled areas of western Washington and Oregon, adding to public concern about large wildlife species. Olympic National Park was established in part to protect these animals and their native habitat and was almost named "Elk National Park." Today, Olympic is home to the largest unmanaged herd of Roosevelt elk (Cervus elaphus rooseveltii) in the Pacific Northwest. Most of the elk in Olympic National Park reside in the park year-round, so their populations are not as influenced by human actions. However, illnesses, such as chronic wasting disease, plague elk in the Rocky Mountains, and could make their way west.

"We don't know when [these diseases] are going to show up or what kinds of effects they could have, but we won't know if we aren't monitoring," Happe said.

Every year, some elk that spend the winter outside Mount Rainier's boundaries migrate into the park. Many of these elk use high elevation forests and meadows in the summer, then migrate out of the park in the fall. Elk at Lewis and Clark also move across multiple jurisdictions. Because these elk move across boundaries, they are influenced by management outside the parks, and by local and global natural and anthropogenic factors. The NPS works with the Muckleshoot Indian Tribe, the Puyallup Tribe of Indians, the states of Washington and Oregon, and other agencies to ensure the long-term health of elk populations and the habitats they frequent.

Scientists believe the lower-elevation herd at Olympic has been stable since the 1950s, although there may be some declines, Happe said. Researchers have only monitored high-elevation herds at Olympic for a few years, so it's too soon to comment on any changes. Sampling is on a four-year cycle, and the first round should be completed in 2012. Scientists plan to release their first set of four-year reports by 2013.

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